RANCH DAY

OCTOBER 10, 1955

New Mexico Experiment Station, New Mexico Extension Service,
and
Agricultural Research Service,
Rocky Mountain Forest and Range Experiment Station, Forest Service

U.S. DEPARTMENT OF AGRICULTURE

Experimental Ranch
New Mexico College of A. and M.A.
Jornada Experimental Range
Agricultural Research Service

PROGRAM

FIFTEENTH ANNUAL RANCH DAY
College Ranch and Jornada Experimental Range
October 10, 1955
Ivan Watson, New Mexico Extension Service, Presiding

8:00 a.m. Leave Dona Ana County Courthouse, Las Cruces, N. M.

8:30 Stop 1 Jornada Experimental Range
Herd Management and Livestock Production on the Jornada Experimental Range — Fred N. Ares
Changes in Grazing Capacity on the Jornada Experimental Range — H. A. Paulsen

9:30 Stop 2 Jornada Experimental Range
Juniper Control as a Range Improvement Practice — J. F. Arnold
The Effects of Prescribed Burning a Grass Shrub Range on Burroweed, Cholla, Pricklypear, Mesquite, and Other Shrubs — J. W. Bohning

10:30 Stop 3 College Ranch, Pasture 2
Mesquite Control Demonstration — K. A. Valentine

11:30 Lunch College Ranch Headquarters

12:45 p.m. Welcoming Remarks
Dr. R. B. Corbett, President, New Mexico A. & M. A. College
Representative of Agricultural Research Service
Elbert H. Reid, Chief, Range Management Research, Rocky Mountain Forest and Range Experiment Station

1:15 Address by President of New Mexico Cattle Growers Association, Sherwood Culbertson, Lordsburg, New Mexico

1:40 The Influence of Management on Cattle Production — Buford Slover, Animas, New Mexico

2:10 Stop 4 College Ranch, Pasture 1
Digestibility of Range Grasses — W. E. Watkins
Will Range Forage Carotene Meet the Carotene and Vitamin A Requirements of Range Cows? — Ward W. Repp

2:50 Stop 5 College Ranch, Pasture 3
Effect of Intensity of Use on Recovery of Drought Damaged Range — K. A. Valentine

3:40 Stop 6 Camp Well
The Effect of Condition on Evaluating Type in Range Cattle — R. L. Blackwell
Selecting Cows by the Weight of Their Calves — J. H. Knox

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JORNADA EXPERIMENTAL RANGE

COLLEGE RANCH

Jornada Headquarters

Camp well

Mayfield well

Co-op well

Seldon well

South well

College Headquarters

Lunch

Summerford Mt.

To Radium Springs

To Las Cruces

LEGEND

1 Pasture number

Boundary

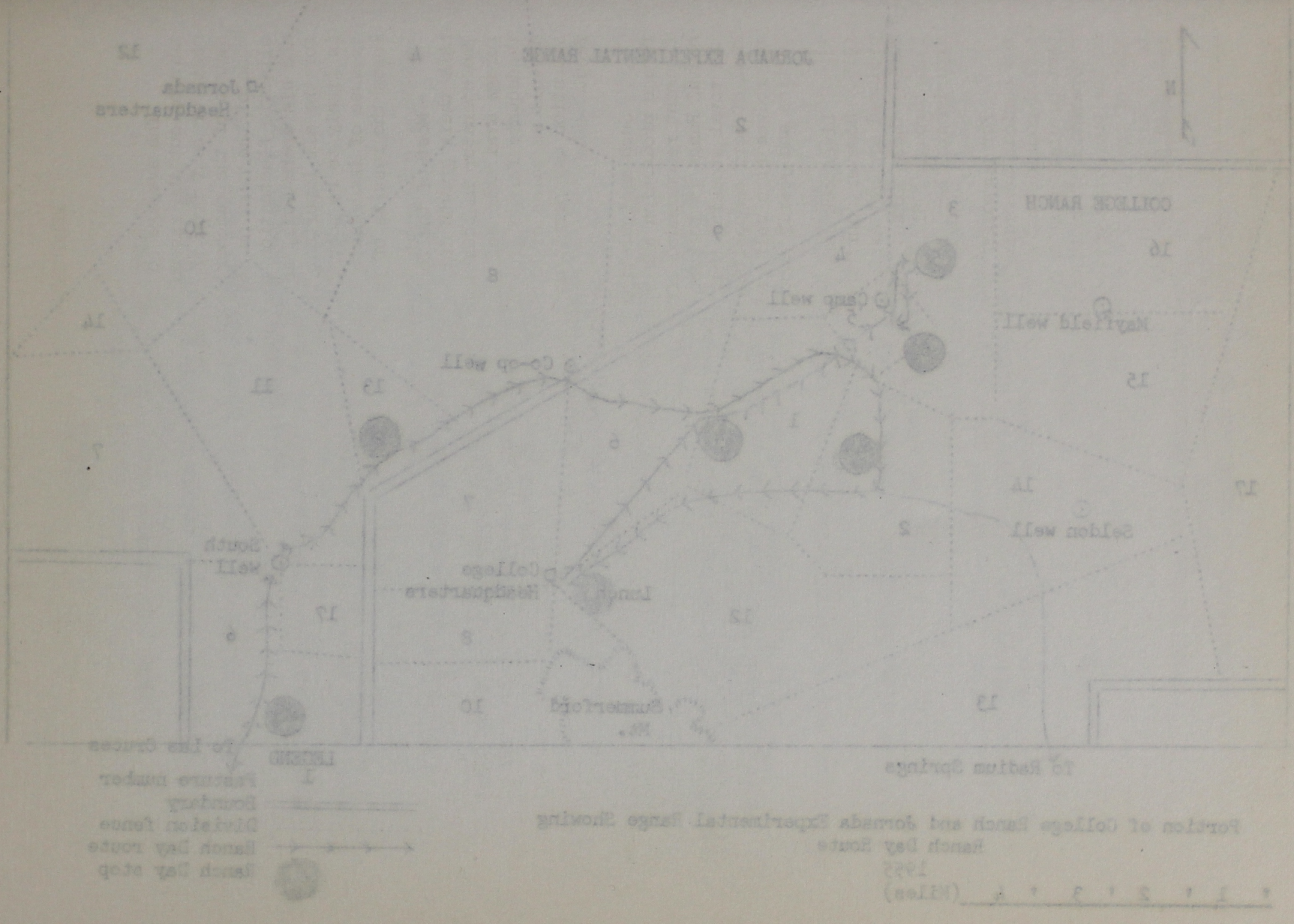
Division fence

Ranch Day route

Ranch Day stop

Portion of College Ranch and Jornada Experimental Range Showing Ranch Day Route 1955

1 2 3 4 (Miles)



HERD MANAGEMENT AND LIVESTOCK PRODUCTION

Fred N. Ares[1/]

The average southwestern ranch is essentially a calf factory, turning out the raw material to be processed later, either as replacements or beef from the feeding lots. Producing this commodity, the chief source of the rancher's income, the breeding cows then become the backbone of the herd on most southwestern ranches. In this region of extreme climatic fluctuation the cattleman must be ever ready to adjust his herd and his operations, as the weather dictates, to provide sufficient feed for the all-important breeding cow herd. The demand for breeding cows is likely to be poor during drought. Moreover, if the operator is forced because of inadequate forage to sacrifice part of his breeding herd, he loses the results of years of selective breeding.

Most of the forage of semidesert ranges consists of grasses which make their growth during the rainy season and provide yearlong grazing. The operator is thus able to judge in the fall of the year the amount of forage available and plan subsequent stocking accordingly. In years of inadequate forage growth this will mean deep culling of the breeding herd as well as sales of all natural increase; on the other hand, an improved situation may permit more cattle to be added to utilize available surplus feed.

Such manipulation of the herd to maintain a balance between current forage production and stocking is basic to good management. A further refinement recommended after years of grazing tests at the Jornada Experimental Range is to keep the herd of breeding cows at a level or ratio of the total stocking that will insure them adequate feed at all times. This kind of herd composition plus the proper stocking rate can be expected to produce high calf crops, low death losses, consistently good beef production and yearly income.

Livestock management methods have been studied on the Jornada since 1915. However, during the early years of the operation pounds of beef produced are not available since many of the cattle were sold by the head during those times. Complete data are available for the 26 years from 1926 through 1951. Because of the present severe drought most of the experimental herd had to be removed following that time.

For purposes of this discussion the 26 years are divided into two periods according to the size and composition of the herd. The first period considered, a span of 12 years from 1926 through 1937, may in large part be classed as a recovery period. During this time the range was recuperating from the heavy stocking and a bad drought in the latter part of the preceding period. Total stocking was reduced by more than half that of previous years; but the proportion of breeding cows was increased to 70 percent of the total herd. During this time the calf crop was increased by nearly 10 percent to an average of 75 percent, death losses

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1/ Range Conservationist, Field Crops Research Branch, Agricultural Research Service, U. S. Department of Agriculture, Las Cruces, New Mexico.

were held at 2.0 percent, and all supplemental feeding was eliminated. These improvements were attributed largely to refinements in grazing determinations and regulation of the rate of stocking to provide forage at all times. This improved record was attained in spite of the severe 1934 drought and changes in the herd which brought in some poor quality. drought-stricken breeding stock.

Low Breeding Cow Ratio Provides Drought Insurance

Total annual adult stocking during the second period (1938-1951) averaged 242 animal units less than in the preceding 12 years, and the proportion of breeding cows was reduced to 57 percent of the total adult stocking (fig. 1). The plan of management for this period resulted in the highest average annual calf crop, 85 percent, and the lowest rate of death loss, 1.2 percent. This was accomplished despite 10 consecutive dry years in which the amount of annual rainfall averaged only 77 percent of the longtime normal. In the last year of this period, 1951, rainfall was less than 4 inches.

Principal emphasis was placed on management that would provide adequate drought insurance. The aim was to eliminate forced removals or sacrifice sales of breeding stock in years of scant rainfall. Conservative stocking and maintaining the breeding cow ratio at an average of 57 percent of the total stocking helped to accomplish this. Reduction in numbers to adjust the stocking to lowered forage supplies in drought years was easily accomplished by selling of calves, yearlings, and dry or cull cows. In the better years, when it was certain that forage would be available beyond the needs of the breeding herd, it was used by holding calves to be sold the following spring as yearlings, or bringing in calves or yearlings for winter grazing.

In the 14-year period forage was sufficient to maintain the total stocking at an average of 998 head annually. In the driest year, 1951, there was enough forage for 705 head. Thus, the breeding cows could have been maintained at a level of 550 to 600 head even during the last 5 years of drought. However, because of favorable market conditions and to provide a continuing cushion against possible continued drought, the breeding cows were culled closely each year after 1946. This opportunistic selling resulted in keeping the breeding herd at a safe level even in successive drought years. It also contributed to low death losses and good calf crops.

Beef Production Stabilized at High Level

Sales records by weight from all classes of livestock are available for the 26 years making up the two periods considered. This has provided information on the production of beef from the range for the two periods that varied in the ratio of breeding cows in the herd (fig. 2). Records show the net live weight beef production.

The average annual production of beef for the 14-year period was 361,636 pounds as compared with 388,519 pounds for the previous 12-year period. This loss of 26,883 pounds average production per year reflects the severity of the 10-year drought since 1941 and the accompanying reduction in total stocking. Until 1949, the eighth year of drought, the total beef production was maintained at the approximate level of the preceding period.

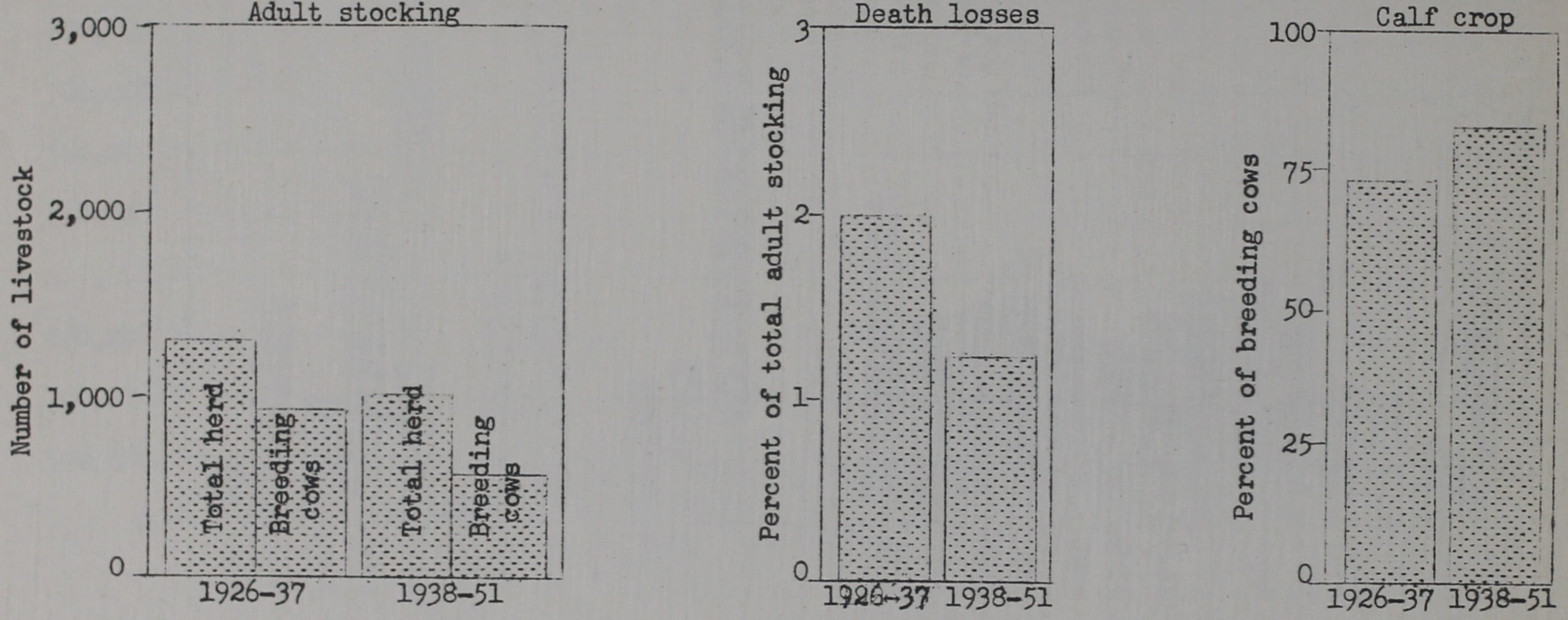


Figure 1.— Average annual stocking rate, herd composition, death losses, and calf crops for two periods, 1926-37 and 1938-51, on the Jornada Experimental Range.

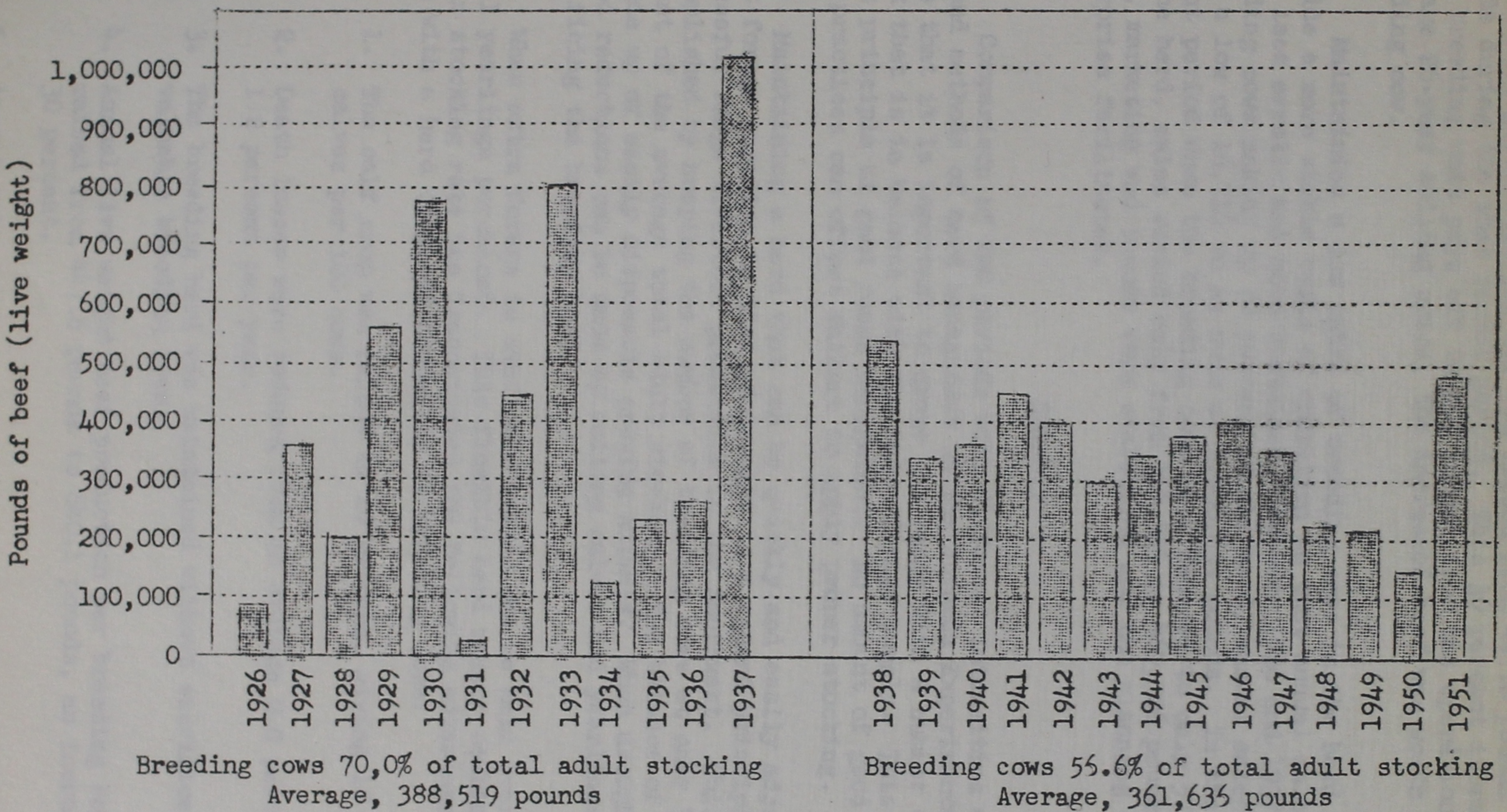
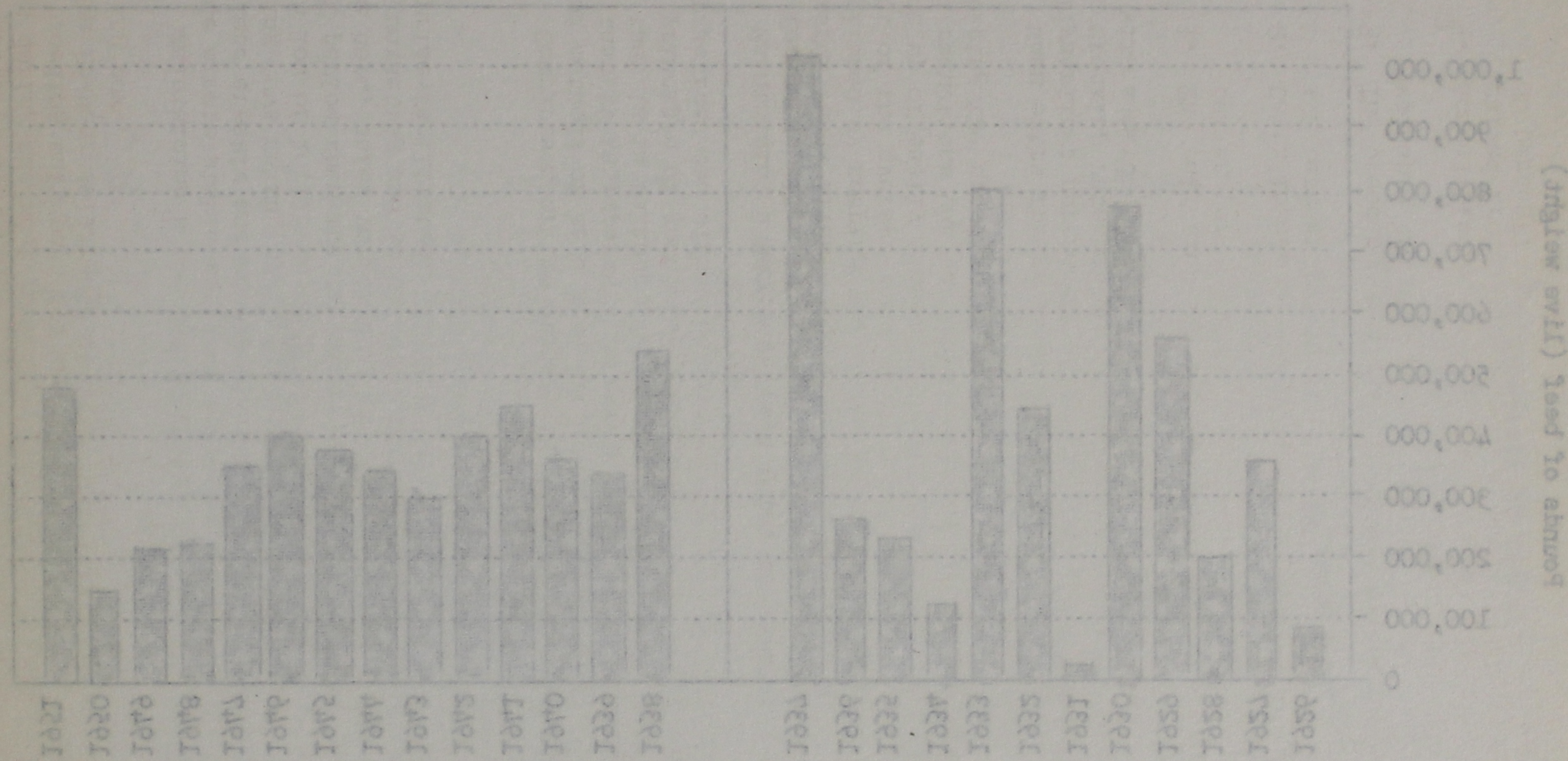


Figure 2.— Annual net beef production from the Jornada Experimental Range during two periods with contrasting ratios of breeding cows in the herd.



Breeding cows 70.0% of total adult stocking
Average, 388,519 pounds

Breeding cows 55.6% of total adult stocking
Average, 361,695 pounds

Figure 2.— Annual net beef production from the Jornada Experimental Range during two periods with contrasting ratios of breeding cows in the herd.

Beef production per cow was raised from 447.6 pounds to 640.1 pounds during the most recent period. This 30 percent increase from each breeding unit pays off in net income from the operation. At the average 26-year selling price, the increased beef was worth $18.09 per breeding cow.

Maintaining a low ratio of breeding cows in the herd helped to provide a more stable basis of operation in that annual sales of beef were less erratic and more sustained. Between 1926 and 1937, with breeding cows making up 70 percent of the herd, annual sales varied from a low of 16,716 to as much as 1,000,834 pounds. In the more recent period when the breeding cows were reduced to only 57 percent of the herd, sales varied only from 155,393 to 469,326 pounds per year. Thus, marketing and income were stabilized and the planning of the entire enterprise facilitated.

Summary

Comparison of two periods with different intensities of stocking and methods of herd management on the Jornada Experimental Range shows that it is important to graze the range with a number of livestock that is in balance with the range forage supply. This is the first principle of good range management. No amount of good herd-management practices can offset failure to apply proper stocking.

Maintaining a herd that can be quickly and easily adjusted to short forage supplies in time of drought is a second principle for successful range livestock production in the Southwest. This can be accomplished by keeping the number of breeding cows at only 55 to 60 percent of the average total adult stocking. The balance of the herd is made up of easily disposable growing animals. When drought strikes, needed reductions can be made by selling calves and yearlings without sacrificing the breeding herd.

When extra forage is available calves can be held over and additional yearlings purchased. This flexible herd makeup combined with a proper stocking rate has demonstrated the following advantages as compared with a herd composed primarily of breeding cows:

1. The calf crop was raised by 10 percent, giving 10 more calves per 100 cows.

2. Death losses were reduced from an average 2.0 percent to 1.2 percent per year.

3. The breeding herd was maintained without sacrifice sales of valuable breeding cows.

4. Annual live weight beef production per breeding cow was raised from 447.6 pounds to 640.1 pounds, an increase of 30 percent.

5. Annual sales were less erratic and more sustained, permitting a more stable and orderly operation.

CHANGES IN GRAZING CAPACITY ON THE JORNADA EXPERIMENTAL RANGE

By

H. A. Paulsen, Jr.[1/]

Grazing capacity is the number of livestock that a given range area will support year after year without damage to the forage resource. In areas where precipitation is not so critical as in the Southwest, stocking may remain fairly constant. But in southern New Mexico climatic fluctuations are so extreme that we are forced to modify our usual concept of grazing capacity.

Since 1915, when the Jornada Experimental Range was set aside, records of climate, vegetation, and livestock have been maintained as part of the research program. During these 38 years systems of management, grazing capacity, and other facets of the range cattle business have also been studied.

Data on changes in grazing capacity at the Jornada have been collected in 6 pastures, which together occupy approximately 140,000 acres of rolling mesa rangeland. They vary widely in surface acreage and also in the kind and amount of vegetation. Pasture areas and the percentage of the various vegetation types within each are shown in table 1. In pastures 5, 9, and 10, grasslands predominate and black grama is the most important type, while in pastures 1, 2, and 6, brush types are the major vegetation.

Table 1.-- Pasture acreage and percentage of vegetation types within each mesa pasture on the Jornada Experimental Range

Pasture	Surface acres	Grassland types				Brush types	
		Black grama	Tobosa	Grama and mixed grass	Tobosa and mixed grass	Mesquite	Tarbush creosotebush
		Pct.	Pct.	Pct.	Pct.	Pct.	Pct.
1	83,961	4.6	5.0	5.1	3.6	46.4	35.3
2	29,512	23.7	3.0	7.8	0.3	65.2	0.0
5	1,780	78.6	0.0	3.5	7.4	10.5	0.0
6	14,658	12.3	1.6	0.4	26.0	1.7	58.0
9	3,172	89.2	0.0	6.2	0.0	4.6	0.0
10	7,172	80.6	0.7	3.0	14.8	0.3	0.6

Stocking and beef production on the Jornada

When the Jornada was set aside as an experimental area, little information was available on the carrying capacity of the semidesert vegetation types. Initial stocking in 1915 for the 6 pastures was

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- 1/ Range Conservationist, Rocky Mountain Forest and Range Experiment Station, Forest Service, U. S. Department of Agriculture.

3,478 animal units, but with a combination of drought years and the accumulation of early information about proper use of this type of range, stocking was 1,523 animal units in 1919. A 5-year period of drought began in 1922 and as a result, in 1926 the grazing capacity was only 68 animal units for the 6 pastures. A series of years when rainfall was generally more favorable began in 1927. Stocking on the 6 pastures averaged 910 animal units from 1927 through grazing year 1951. During this period individual years were often extremely dry. When they were sandwiched between more favorable years their effects on the production of forage were somewhat modified. However, a group of dry years occurred, including grazing years 1944, 1946, 1948, 1949, and 1950, when seasonal precipitation averaged 35 percent below normal. This again lowered the production of forage on the 6 pastures and total stocking was 321 animal units in 1952.

Although animal unit numbers have varied, beef production on the Jornada was maintained at approximately the same level through the period 1926-1948. Beef production per cow was raised from an average of 448 pounds in the period 1926-1937 to 640 pounds during the period 1938-1951, which compensated for the fewer cattle grazed on the average during the latter period.

Changes in grazing capacity by pastures

Records of stocking and grazing capacity for all pastures combined are interesting, but it is more revealing to consider the pastures individually. Pasture acreages have changed slightly over the years but for simplification the acreages given in table 1 will be used as the basis for pasture comparisons of grazing capacity by surface acres per animal unit.

As previously brought out, the 6 pastures fall logically into 2 groups: 3 which contain a relatively large proportion of brush types and 3 which are predominantly grassland. Thus, pastures 1, 2, and 6 contained 60 to 82 percent brush in 1928 with the remainder in grassland type vegetation. In contrast pastures 5, 9, and 10 contained only 1 to 11 percent brush type. This grouping is followed in the construction of figure 1. The figure shows the general trend in the surface acre requirement per animal unit for each pasture from 1916 through 1953.

The grazing capacities of the pastures that are mainly grassland have changed but little during the years. If the recent drought years are omitted, even the slight reductions in grazing capacity, which are indicated by an increased surface acre requirement per animal unit, would be virtually eliminated for pastures 9 and 10. Both these pastures were used mainly in the winter-spring period. Pasture 5 was grazed yearlong in most years and 10 percent of its area was occupied by mesquite type, both of which could have resulted in a gradual overall decrease in grazing capacity. However, during the 2 periods of severe protracted droughts, in the middle 1920's and in the late 1940's and early 1950's the grassland types produced so little forage that they had essentially no grazing capacity.

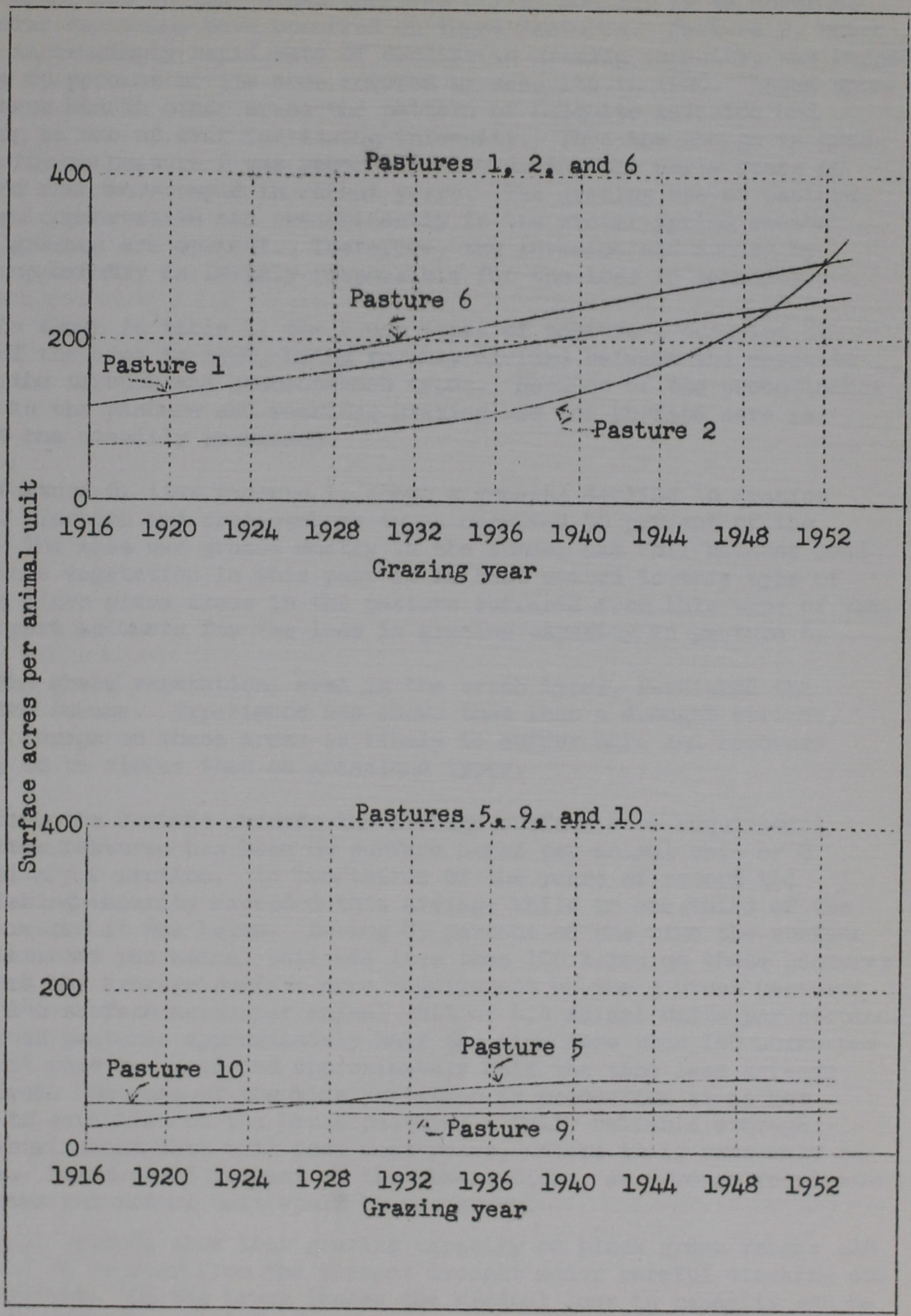
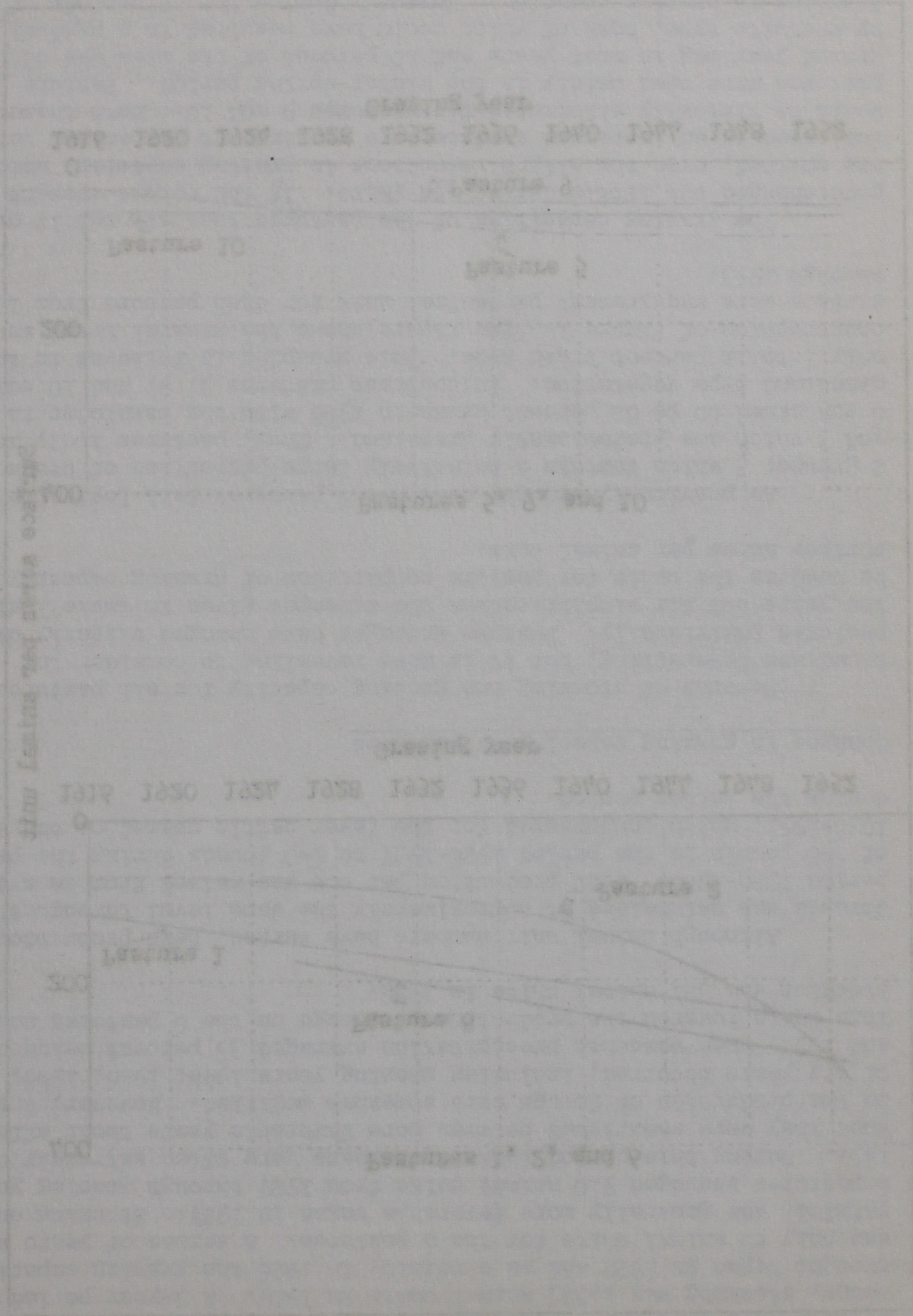


Figure 1.— Surface acre requirements per animal unit on six experimental pastures, Jornada Experimental Range, 1916 - 1953, inclusive.



By inspection of the lines in figure 1, which represent average grazing capacities on the brush pastures (1, 2, and 6), it is apparent that general decreases have occurred on these pastures. Pasture 2, which shows an increasingly rapid rate of decline in grazing capacity, was mapped as having 65 percent of its area covered by mesquite in 1928. Based upon studies here and in other areas the pattern of mesquite invasion and thickening is one of ever increasing intensity. Thus the change in grazing capacity in pasture 2 was generally slow during the early years of record and much more rapid in recent years. The grazing use of pasture 2 has been conservative and predominantly in the winter-spring season when the grasses are dormant. Therefore, the invasion and duning by mesquite apparently is largely responsible for the loss in capacity.

As shown in table 1, the brush types of pasture 1 occupied 82 percent of the area in 1928, being roughly divided between the mesquite type and the tarbush and creosotebush types. Because of the predominance of brush in the pasture and yearlong grazing use the surface acre requirement has steadily increased.

Pasture 6, like pasture 1, shows a general decline in grazing capacity. Tarbush and creosotebush types occupied 58 percent of the pasture. The area was grazed mostly in the summer and fall because most of the grass vegetation in this pasture is best suited to this type of use. The black grama areas in the pasture suffered from this type of use, which in part accounts for the loss in grazing capacity in pasture 6.

The grass vegetation, even in the brush types, furnished the bulk of the forage. Experience has shown that when a drought strikes, the grass forage on these areas is likely to suffer more and recovery is likely to be slower than on grassland types.

From the Jornada records the average surface acre requirement of the grass pastures has been 80 surface acres per animal unit or 8 animal units per section. In two-thirds of the years of record the yearly grazing capacity exceeded this average while in one-third of the years of record it was below. During 85 percent of the time the surface acre requirement per animal unit was less than 100 acres on these pastures. By contrast the average surface acre requirement on the 3 brush pastures has been 146 surface acres per animal unit or 4.4 animal units per section. On the brush pastures approximately half the time more than 146 acres per animal unit were required and approximately half the time less acreage was required. Because of the wide variation in production it is not possible to establish on the brush pastures a fully reliable average acreage requirement that will meet most years, unless it is extremely conservative. Based on 85 percent of the observations, an acreage requirement of 222 acres per animal unit would be necessary.

Past records show that grazing capacity on black grama ranges can be expected to recover from the present drought under careful stocking and wise management. On the brush ranges the gradual loss in capacity can be expected to continue until brush control or some other range improvement measures are undertaken. It is also apparent that a sustained grazing capacity does not exist on the semidesert ranges of this area. Rather, there are periods of high forage production, favorable to the range cattle business, and also periods when stocking is not practicable because of low forage production.

JUNIPER CONTROL AS A RANGE-IMPROVEMENT PRACTICE IN CENTRAL ARIZONA

Joseph F. Arnold[1/]

Juniper and pinyon pine are being controlled at an increasing rate by ranchers and Federal agencies to improve the ranges of central Arizona. I would like to report on some methods of removing juniper and on the results being obtained. My remarks are based on observations made while studying the factors affecting condition and production of juniper ranges.

Before a range-improvement practice such as juniper control receives widespread acceptance there has to be some assurance that the benefits will justify the costs. It is a little early to evaluate fully the economic effects of removing juniper. Costs and benefits, of course, vary with how thoroughly junipers are cleared from woodland ranges and how well they are managed following control. Let us look at some of the methods used to clear juniper and then at the possible benefits.

Methods

Methods commonly used to control undesirable woody plants include (1) chemical, (2) biological, (3) mechanical, and (4) controlled burning. Practical chemical and biological control methods for juniper and pinyon pine have not been developed. Mechanical methods have been developed and used most extensively by ranchers and land-management agencies. Possibilities for using fire are being tested.

Mechanical

Several mechanical control methods are being widely used in central Arizona to clear juniper on large projects.

1. The Fort Apache Indians are using hand axes to clear juniper from their woodland ranges at an estimated cost of $5 to $7 an acre. The average wage scale is about $6 a day. This high cost is justified because hand clearing gives employment to Indians who would be idle during off-season winter months.

It is estimated that the Fort Apache Indians have averaged about 5 percent a year of the area they plan to clear, although the acreage treated annually has been increasing each year. They have cleared about 80,000 acres during the past 9 years, about 20,000 acres during 1954 alone.

Hand clearing is generally more thorough than methods using heavy equipment because small trees are removed that usually escape heavy equipment. Hand clearing with axes and grubbing hoes can't be beat for removing small scattered trees that are just beginning to invade grassland ranges. Use of expensive heavy equipment is probably more costly than clearing small scattered trees by hand.

The use of small portable chain saws may have a place in clearing stands of scattered trees, even though this equipment has not been widely accepted.

1/ Range Conservationist, Rocky Mountain Forest and Range Experiment Station, Forest Service, U. S. Department of Agriculture.

2. Cabling or chaining is probably the least expensive method for uprooting old dense stands. Although costs generally average $1 to $1.50 an acre, the costs on a couple of projects run as high as $2 an acre. This method is least expensive and most effective on stands of old mature trees and on terrain that is fairly smooth and comparatively free of rocky outcrops. About 300 feet of 2-inch cable or a ship's anchor chain is dragged between two tractors of the largest available sizes. The cable slips over small trees and merely tips over many intermediate-sized trees so that only the large trees are killed.

A heavy layer of slash and debris is left by the cabling of dense stands and poses a serious problem because large trunks and branches remain undecomposed for many decades. The use of fire is being tried in several places to reduce the heavy slash and kill many of the live trees left after cabling. Because of intense heat, burning leaves spots that remain barren of desirable forage plants for many years. Reseeding after burning is also being tested to see if these burned spots can be revegetated in a comparatively few years. Of course, costs increase where cabling has to be followed by burning and reseeding. But even with additional costs cabling may still be cheaper than methods that remove individual trees. Clearing dense stands by individual trees is very costly.

Slash offers no problem where light stands are cleared by hand axes or dozers. Limbs and branches of dead trees that are scattered over the range are desirable because they protect small patches of grass that help reseed cleared ranges.

3. Dozer equipment used to uproot individual trees comes in assorted designs and sizes. In general, most dozer equipment has a pusher bar that tips over the tree in front of the dozer blade. The dozer blade catches the partially uprooted tree to complete the job.

The Hulacat, developed by Mr. H. A. Mullin of the Forest Service, is a specialized piece of dozer equipment that deserves special mention. The pusher bar and dozer blade on this equipment can be tilted either to the right or left by hydraulic power. The dozer blade is equipped with 2 teeth in the middle and 1 at each end. The Hulacat can scoop out small to medium-sized trees with either the right or left side of the dozer blade while in a continuous forward motion. As a result, this equipment requires fewer operations in reverse gear.

The Ralston tree lift is essentially a hydraulic scoop mounted on a heavy commercial tractor. In operation the tree-lift attachment is raised to push over large trees. The tractor backs up, lowers the scoop, and lifts out the tree as it is driven forward. Although the equipment is somewhat light for large trees and for operation in dry and rocky soils, its main advantage is that its purchase price is less than heavier crawler-type tractors.

Costs of removing individual trees with dozer equipment vary with size and design of machines, size and density of tree stands, soil conditions, efficiency of the operator, and other factors. Costs generally vary from 4 cents to 13 cents a tree with an average of around 7 cents.

1. Controlled broadcast burning of live stands of pinyon-juniper has been regarded as a possible cheap means of clearing. Observations so far indicate that broadcast burning may be limited to only the most dense stands. An accidental fire in 1953 on the Hualapai Indian Reservation burned over about 25,000 acres where the stands averaged around 500 small trees per acre. The fire did not carry very far into stands of 300 or less mature trees per acre. This fire burned in the hottest, driest part of June. A number of attempts to set fire to stands of old trees in June have met with failure, even when oil was sprayed on the trees to get the fire started. Broadcast burning as a means of clearing juniper needs considerable research to determine under what conditions burning is practical or desirable and what precautions are needed to assure successful establishment of grass stands on the burned areas.

2. Burning of individual trees in open stands has been tried by a number of methods. Some ranchers have tried spraying a little kerosene around the base of the tree and then touching a match to it. One rancher scatters oil-saturated sawdust around the base of individual trees and then touches it off with a match. Another method involves chopping off the lower branches of a tree and setting them afire after they have dried. Ranchers, with the help of commercial companies, are trying to develop butane gas burners that can be used economically to kill junipers. One rancher reports killing junipers at about 2 cents per tree, including costs for labor and equipment.

As with broadcast burning, more knowledge and research are needed before use of fire on individual trees can be used safely. We need to know how to control fire and how to minimize damage.

Several kinds of junipers grow on Arizona ranges. One kind, alligator juniper, is difficult to kill because it sprouts profusely from the base when only the top is killed. Better results have been obtained with nonsprouting species.

Benefits of Juniper Control as a Range-improvement Practice

We have only preliminary results to indicate the benefits that can be expected from juniper control. It will probably take several years before the full benefits can be assessed.

On the Fort Apache Indian Reservation juniper control has more than tripled herbage yields of forage plants from less than 200 pounds to about 670 pounds per acre on protected or winter-grazed areas in 10 years (fig. 1). Increases in production will be much less on yearlong ranges or on ranges that are overstocked. For woodland ranges that are properly stocked and used, juniper control should increase the production of livestock products in proportion to the increases in herbage yields.

The West Bear allotment on the Prescott National Forest gives us a good example of benefits. Juniper control was started in 1951 and continued through 1954. By 1954, 7,100 acres were treated, an area that is equal to 20 percent of the allotment. Samples taken at the end of the 1954 growing

season averaged 375 pounds per acre, while samples from the uncontrolled juniper stands averaged only 45 pounds per acre.

The allotment furnished 3,430 animal months of grazing over a 7-month winter-spring season before juniper control started. This rate of stocking was gradually increased by the Forest Service to 4,950 animal months during the 1953-54 grazing season, or an increase of about 45 percent. The season of use was extended this year from 7 to 7½ months.

Juniper control may benefit game birds and game animals. Quail seem to have increased in the juniper-control area near Drake, possibly because of better habitat conditions. Deer, elk, and antelope ranges can be improved where the removal of overstory trees has released excellent understory browse plants like cliffrose and winterfat. But juniper control will also release undesirable understory shrubs like rabbitbrush that must also be controlled to give full release to forage species.

Future Needs

Our present evaluations of methods, costs, and benefits are still at a preliminary stage. Looking to the future we need:

1. To develop more efficient mechanical methods to reduce the costs of controlling juniper.

2. To examine and develop chemical control methods that will be practical.

3. To examine the possibilities of biological control treatments.

4. To learn how, when, and where fire can be used safely as a control practice.

5. To determine whether supplemental treatments such as burning slash and reseeding are desirable and justify the additional costs.

6. To find out how to graze after clearing to get maximum returns.

7. To determine what methods are best suited to maintain cleared areas against reinvasions.

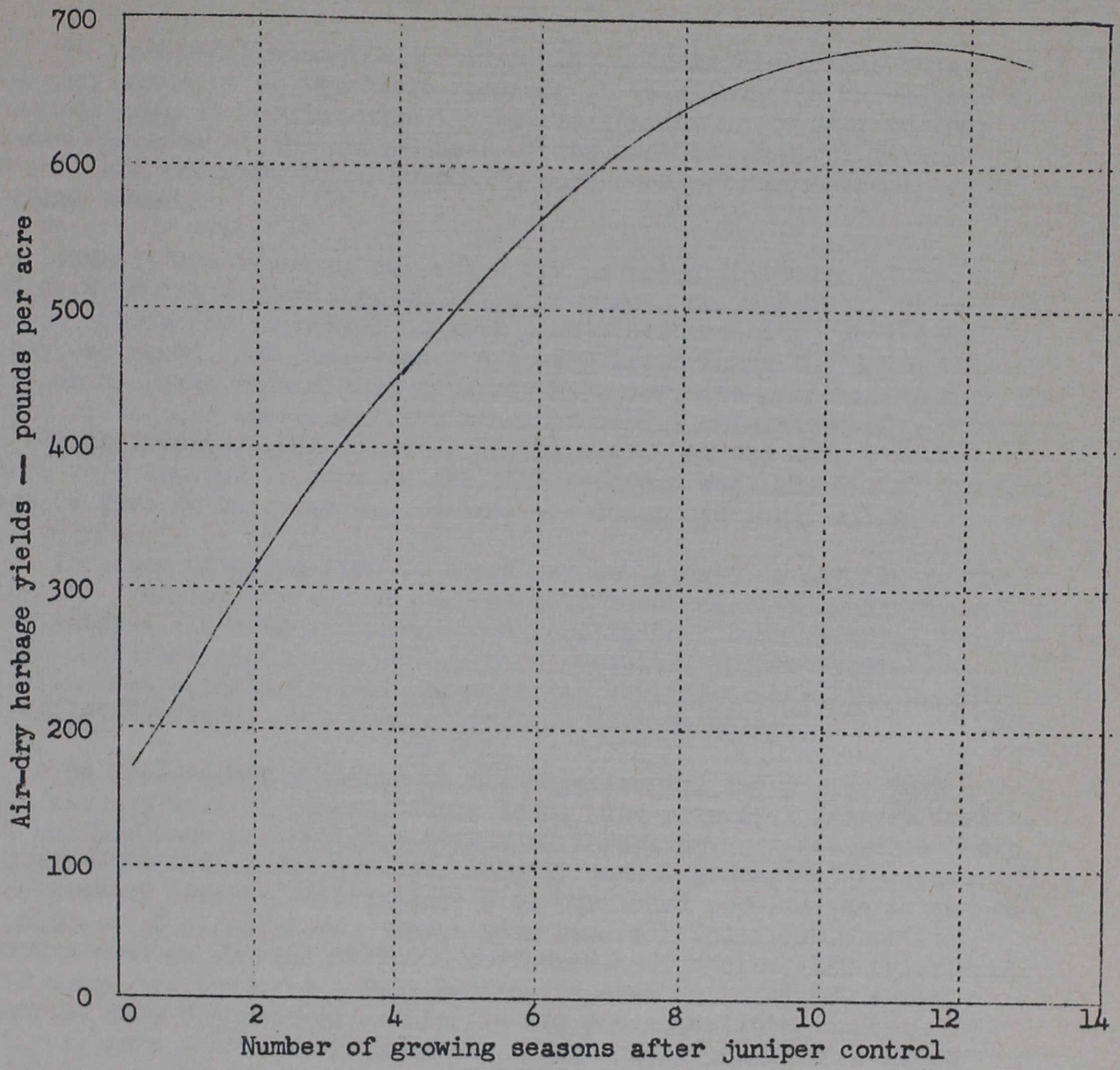


Figure 1.— Rate at which herbage yields increased after juniper was controlled on protected or winter-grazed sites.

THE EFFECTS OF PRESCRIBED BURNING A GRASS SHRUB RANGE ON BURROWEED, CHOLLA, PRICKLYPEAR, MESQUITE, AND OTHER SHRUBS

John W. Bohning[1/]

It is a well-recognized problem that undesirable plants have invaded many acres of southwestern rangeland. This invasion has caused a tremendous loss in grazing capacity and is continuing to make further inroads. Because of the seriousness of the problem, control methods have been and continue to be sought through chemical, mechanical, and other means.

Fire is one means of control which is being investigated for its possible value in controlling undesirable plants on rangelands of southern Arizona. There the principal noxious plants are mesquite, cholla and pricklypear cacti, and burroweed. A controlled burn on the Santa Rita Experimental Range showed that fire may have definite possibilities in the control of some of these species, since it nearly eliminated burroweed and made strong inroads against cactus on the area. At the same time the grasses were damaged to some extent, but recovery was made within 3 years. Effect of fire on mesquite on the area was disappointingly slight.

The idea of using fire to check noxious plants is not new in the Southwest. Varying degrees of success have been reported by different investigators. In some instances good results have been reported, not only on burroweed and cactus but also on mesquite. Other studies resulted in less success against mesquite; an earlier burn on the Santa Rita killed few trees over half an inch in stem diameter.

The area recently burned on the experimental range lies on a gently sloping mesa of coarse, sandy loam. The principal grasses include black and Rothrock gramas plus a number of threeawns. In favorable years there are abundant annual grasses, largely annual gramas and threeawns. At the time of burning, all grasses plus burroweed provided an estimated 600 pounds of fuel per acre. There were numerous undesirable plants; a count showed an average of 3,200 burroweed, 400 cholla, 110 pricklypear, and 70 mesquites per acre. This particular area embraced 100 acres; another of only 6 acres was similar in its characteristics except for relatively more abundant black grama. Since black grama is so highly desirable as a forage species, consideration of it is included to check particularly the effect of fire on that species. Burning was done in June just prior to the summer rains.

Two growing seasons later the burn was checked to determine the effects of the fire on the undesirable species. The time lapse was used to allow plants that appear to be dead opportunity to sprout. A count showed 88 percent of the burroweed, 67 percent of the barrel cactus, 44 percent of the jumping cholla, and 42 percent of the cane cholla were killed. Only 28 percent of the pricklypear cactus and a meager

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1/Range Conservationist, Rocky Mountain Forest and Range Experiment Station, Forest Service, U. S. Department of Agriculture.

9 percent of the mesquite were found to be casualties of the fire. Lesser mortality of the pricklypear than other cactus is explained by the observation that the pads fell to the ground as the fire burned up through the hearts of the plants, and they frequently took root where they fell.

No mesquite trees larger than 6 inches in diameter were killed. Many trees were protected from the fire by a ring of grass-free ground where the grasses had been unable to compete with the mesquite. Some trees 6 inches or less in stem diameter were killed by the fire. All trees under 2 inches in diameter were damaged by fire. In the size classes between 2 and 6 inches, damage decreased as stem diameters increased. However, among these smaller size classes there was little difference in actual mortality.

As would be expected, the perennial grasses, too, were damaged by the fire. When measured the first fall following burning, the average density of these grasses had decreased one-third. By the second fall density had increased so that it was only 14 percent less than companion unburned areas, despite poor growing conditions in the two intervening summers. The third summer received rainfall of 135 percent of average, and by the following fall the perennial grass density on the burned area exceeded the unburned by 4 percent.

Not all species of perennial grasses reacted alike to fire. Santa Rita threeawn suffered most, followed in degree of damage by Rothrock grama and Arizona cottongrass. Of these grasses, the cottongrass and threeawn are very good forage species and Rothrock grama is of intermediate value. The relative rates of recovery differed, too; after 3 growing seasons Santa Rita threeawn was still losing ground, while Rothrock grama made strong gains when favorable summer rains occurred. Arizona cottongrass made good gains but they were less than those made by Rothrock grama. Black grama, one of the most valuable forage plants, was the perennial grass most seriously damaged by the fire. On the small area where black grama is the principal species, damage to it was still apparent after 4 growing seasons. It still had not regained its preburning density, although cottongrass and other perennials had made up their losses in 2 growing seasons.

Herbage production of perennial grasses in the year of burning was down 50 percent from the production on the check area. The next year perennial grass production equalled the comparable unburned area even though density of the grass had not regained all its losses. It also equalled the production on the unburned area in the third year. Also, the third year was a favorable year for the growth of annual grasses. With more favorable moisture conditions on the burned area, annual grass herbage production exceeded that of the unburned area by 150 pounds per acre. It is expected that the perennial grasses will eventually occupy much of the space now supporting annuals.

With the reduction in cover caused by the fire, it was only natural that soil movement increased following burning. Burning in June bares the soil just before the summer rains, which are often torrential. Assuming that soil stability would parallel vegetative recovery, it would require 2 growing seasons to return the soil to the same level of stability that existed prior to burning.

On the smaller burn, soil samples were taken and analyzed to determine if any changes in soil constituents took place. Samples were collected under large mesquite trees, beneath heavy stands of burroweed, and in black grama. It was found that, in general, the amount of available plant nutrients was increased by burning. Based on the experience gained in other such analyses, such increases can be expected to last for only a year or two.

Summarizing this material presents the following picture. On the areas burned, herbaceous material prior to the burn approximated 600 pounds per acre. Mesquite larger than 2 inches in stem diameter numbered no more than 50 per acre, but burroweed, and cholla, pricklypear, and barrel cacti were abundant. Burning during June when the weather was hot and dry practically eliminated burroweed and drastically reduced the stands of cholla, barrel, and pricklypear cacti. Mesquite mortality was disappointingly low. Total perennial grass density was decreased one-third, but had regained and even exceeded its pre-fire level at the end of 3 growing seasons. Under the weather conditions which occurred following burning, Arizona cottongrass, Rothrock grama, and a variety of threeawns have recovered from the setbacks caused by burning, but black grama is recuperating much more slowly. Of these species, black grama is most valuable as a forage plant followed by Arizona cottongrass, Santa Rita threeawn, and Rothrock grama. Other species of threeawns are of lower value.

These observations indicate that fire may be a valuable tool for controlling burroweed and reducing stands of cactus at the cost of a temporary loss in grass density and forage production. The most serious loss would be the slow recovery of ranges which are predominantly black grama, since this plant appeared to suffer more lasting damage from fire than its companion species. Where control of mesquite is the only benefit sought by burning, it would be cheaper and more effective to kill an equivalent number of trees per acre by the basal application of diesel oil, judging from the low mortality rate attained on the burns considered here.

These experiments with the use of fire in controlling undesirable range plants, while promising, are not in themselves sufficient to recommend widespread use of burning as a plant-control measure. Additional tests are needed. The effects of burning can be expected to vary with topography, soil types, plant cover, climatic conditions, and other factors. However, exploration into these effects by additional experimental burns may evolve techniques which could prove very useful against noxious plants on southwestern ranges.

A SUMMARY OF MESQUITE CONTROL EXPERIMENTS ON THE COLLEGE RANCH

K. A. Valentine

We are making this stop today to present some results on mesquite control experiments conducted on the ranch during the past few years. As you probably know, mesquite invasion of grassland range is one of the most serious problems facing the user and administrator of rangelands in the Southwest. When rangeland of this type becomes fully occupied by mesquite, by far the greater part of its grazing value is lost; in fact it becomes submarginal waste land. The problem is doubly serious under conditions represented by this range for two reasons: First, range of this type is so low in productivity that cost of control, even when reduced to a minimum and which would be considered moderate on more productive range, is relatively high. Brush infestation does not have to be heavily damaging before cost of control becomes prohibitive. Next, when infestation does reach a high degree, black grama, the most valuable grass for this type of range, is forced completely and permanently out. Thus, irreparable damage is done, even though a mesquite-control method of greatly reduced cost were to become available and put into practice later. There is then, a real urgency to the problem and its solution that needs to be understood and appreciated by all who have any interest in maintaining the range in good, productive condition. In this connection, it is perhaps well to point out that much of our semidesert grassland range is already at least lightly invaded and control work should be started now, when it can be done most effectively and at least expense.

Experimental mesquite control on the ranch has consisted largely of foliage spraying with the growth-regulating, hormone-like chemicals 2,4-D and 2,4,5-T.1/ In the course of this work, we have found that several factors are of importance in the effectiveness of the spray treatments. Careful consideration must be given to these in order to obtain acceptably good results; in fact, if proper consideration is not given to these points, failure will result, and time and money will be wasted. These points are discussed briefly below.

KIND OF HORMONE SPRAY: Our earlier work has shown definitely that 2,4,5-T is much superior to the chemically very similar 2,4-D for foliage spraying of mesquite. The 2,4,5-T is also superior to the 2,4-D - 2,4,5-T mixtures. The 2,4,5-T is more expensive than 2,4-D but its greater effectiveness more than offsets the additional cost. It should be pointed out here that we are considering only foliage spraying of mesquite; 2,4-D is more effective on certain other plants, mainly herbaceous ones, than is 2,4,5-T.

FORMULATION OF 2,4,5-T: By formulation is meant the particular chemical combination in which the 2,4,5-T appears. The low volatile esters of the 2,4,5-T acid have given appreciably better results with us than other formulations and of course should be used under similar conditions.

1/ 2,4-dichlorophenoxyacetic acid, 2,4,5-trichlorophenoxyacetic acid, and their derivatives.

CONCENTRATION: Concentration or strength of spray solution is obviously an important factor in spray effectiveness. We have obtained our best results with 0.15 percent (15/100 of 1 percent) concentrations, computed on the basis of 2,4,5-T acid. Nearly as good results have been obtained with 0.2 and 0.25 percent concentrations, but since increased concentration means increased cost, unless effectiveness is increased in proportion to cost, the increase in concentration is inadvisable. One-tenth percent and lower concentrations have produced considerably poorer results and should not be used.

Since proper concentration is important, care should be taken in making up spray solutions. A 0.15 percent solution is obtained by using about 2.5 pints of low volatile ester stock solution as it comes from the can (the amount varies a little with different manufacturer's products) to 100 gallons of water. Small departures or discrepancies in measuring are of course not serious, but large departures should be avoided.

SEASON: Season, or time of year, has been found to be an important factor in effectiveness of control. Seasonal effects are of course related fundamentally to growth conditions or stages of the plants. Our work has shown best results, on the average, from the time the leaves are fully grown till about the time the beans are full length but not filled out, and still quite green in color. In some years this optimum period has been as short as 15 days and in others as long as 45 days. This optimum period usually includes the latter week or 10 days in May and the first 10 days or 2 weeks in June in this locality. One should not be guided primarily by calendar dates, however, in timing spraying, but rather by the growth stage of the plants themselves. Spraying before and after the optimum period produces much poorer results and should not be attempted.

YEAR EFFECTS: As with seasonal effects within the year, results from year to year vary widely and perhaps from similar causes, that is, growth conditions of the plants. Years which produce good thrifty growth during the May-June season show much higher kills than years of poor growth during this period. Spraying should not be attempted in years of poor growth but should be done on as large a scale as possible in the favorable years.

ADDITIVES: Additives are materials added to the spray solution to increase its effectiveness, such as spreaders, stickers, emulsifiers, materials to suppress evaporation, etc. To date, tests using these materials have not indicated clearly that they are worthwhile, but some results are contradictory and further testing is needed.

OTHER FACTORS: Certain other factors appear to influence results and deserve to be mentioned here. First, windburn and sandblasting of leaves, particularly young tender ones, so that they fail to develop and function normally, seem to reduce effectiveness of spraying. Insect damage to leaves, twigs, and larger stems also impairs effectiveness. Such damage may take the form of leaf curling by aphids or caterpillars, leaf tying by caterpillars, heavy feeding by leaf hoppers, or stem hollowing or girdling by beetles. All have the effect of reducing leaf surface or function and impairing action of the spray chemical. It is probably inadvisable to spray when such damage is intensive or widespread.

Breaking off leaves, twigs, and stems before or after spraying appears to reduce kill. On a practical basis, this means that running over plants sprayed or to be sprayed with cars or trucks should be avoided.

Spray coverage is another factor that greatly influences results. Any twig or small branch that is missed will remain alive and with it living tissue down to the root crown, which will regenerate a new plant in time. Special care should be taken to spray the larger plants in a systematic manner, starting at one extremity and working back and forth until all branches and twigs are covered. Large plants are also best sprayed from two or three sides, to get complete coverage. Particular care should be taken to cover low branches and inside branches, which may be obscured by other branches or even other plants. A little time spent in training sprayers on these points will be well spent.

FIELD SCALE TESTS: As our small-scale experiments have progressed and shown promise, we have tried to enlarge upon them when this seemed warranted in order to obtain information as to cost and effectiveness on a field-scale basis. This year appeared very favorable from early indications and we put in the largest field-scale trial yet made on the ranch -- a 100-acre block. This is certainly not large by comparison with the total area needing control, but is large enough to be fairly indicative of costs and effectiveness.

In this kind of work we try to combine the most effective variations or conditions indicated in the other experiments. Thus we use the best formulation of the best material, in the best concentration at the best season, etc. Accordingly we use the low-volatile ester of 2,4,5-T in 0.15 percent concentration. The work was done on May 17, 18, and 19, and June 1 and 2.

The 100-acre block lies just a little to the west of this location and is not conveniently reached from our Ranch Day route, but it is pretty well represented by the small sprayed area where we are now stopped. Mesquite plants of all sizes averaged 81 plants per acre over the 100 acres. It is too soon after treatment to make a definite statement as to results of the work, as sprouting may occur next year or even the second year after treatment. However, we have found in the past that early results are fairly indicative of final results. This year we are pleased to observe that early results are about as good as we have ever seen in any of our work, and we are looking forward to good final results.

Cost of the spraying this year has been figured to be 98 cents per acre, distributed as follows: Material, 39 cents; labor, 45 cents; and equipment, 14 cents. This cost is the lowest we have computed for field-scale spraying. In 1951 cost was estimated to have run about $1.75 per acre, but mesquite plants numbered 125 per acre. Even the lower cost computed for this year's work represents quite a considerable investment for this type of range and emphasizes the desirability of getting on with control work early, when the infestation is much below what it is here.

In connection with the subject of cost and effectiveness of control, it should be pointed out that no method known to us is the equal of hand grubbing when done in time, that is, when plants are small and few in number.

No expensive equipment or material is needed, nor are kills influenced by the factors which adversely affect foliage spraying. Time required for control by hand grubbing of small plants on about 600 acres in 1950 and 1951 was about one-quarter man-hour per acre.

EQUIPMENT: There is considerable variety in equipment suitable for range spraying, from complete commercially manufactured trailer-mounted rigs to home-made or home-assembled outfits such as we have here. We have no information on comparative performance of different types of equipment. We have found that the "arms" that you see on our rig, which carry the hoses up and out from the pickup, are well worth using. They keep the hoses from hanging on many plants near the pickup, and aid greatly in moving the hoses forward. They also keep the hoses out of the way of a middle sprayer when one is used. The spray guns we are using are light orchard-type guns with nozzles which adjust from a fine spray to a hard driving compact stream. Both these spray shapes and intermediate ones are useful in spraying brush.

SUMMARY: In closing this discussion, we would like to leave the following points with you:

1. Mesquite is an aggressive, well-adapted shrub that has invaded and is still invading our grassland ranges, and in so doing is greatly reducing their grazing value.

2. Good grazing management alone will not keep it out or crowd it out once it is established; artificial control measures are required.

3. Foliage spraying with 2,4,5-T, if done in time and with proper attention to influencing factors, is an effective method of control.

THE DIGESTIBILITY OF RANGE GRASSES

W. E. Watkins

The digestibility of many of the important grasses in many areas of the country has been determined but in this particular area of the Southwest this important work had not been attempted prior to 1949. There was no information on the digestibility of blue grama, black grama, tobosa, and other important range grasses.

Five years' work has just been completed upon the digestibility of some of these range grasses and is being reported in the New Mexico Agricultural Experiment Station Bulletin No. 400. This paper deals largely with the results with blue grama because this grass represented several stages of maturity and was tested most often. Blue grama was secured from five areas of New Mexico which include Cimarron, Lovington, Las Vegas, Mescalero, and Tucumcari. Various qualities are represented from near maturity to that of severely weathered and leached. The results of digestion trials with sheep on these gramas are presented in table 1.

There are no immature grasses represented among these blue grama tests, as this series represents blue grama harvested shortly before maturity and also when weathered. The protein content was 6.8 percent for the best quality and ranged to a low of 2.4 percent. The digestibility of this protein ranged from a high of 46 percent to a zero value of the weathered blue grama. In turn, the amount of digestible protein the animal obtains from the grasses decreases rapidly as the quality goes down. In the weathered forage there is a greater loss of protein from the animal's body than is taken in.

The crude fiber content was 33 percent for the best quality blue grama while the poor quality grass contained 38 percent. The low fiber grass had a crude fiber digestibility of 55 percent while the high fiber grass still had a crude fiber digestibility of 50 percent. The digestibility of 50 percent of the fiber of a weathered grass is not high but it is surprising that it is as high as it is. It is important to note how the sheep ate only half as much of the weathered grass as of the best grade. Then in trial 9 where cottonseed meal was added to the weathered black grama, the sheep ate twice as much. It has been demonstrated at several experiment stations that adding protein to a protein-deficient forage will greatly increase the consumption of forage.

The total digestible nutrients found in the blue grama grasses ranged from 45.2 percent for the best quality to 35.8 percent for the weathered grasses. This top value of 45.2 percent is 97 percent of the total digestible nutrients given by Morrison for mature western prairie hay. This weathered grass has a low amount of digestible nutrients. It is a challenge to find ways and means of increasing this digestibility. There are many experiment stations, including New Mexico, that are studying various supplements and their effect upon ruminant digestion.

A nearly mature black grama was tested in trial 16. The results were only slightly higher than for the best blue grama. This black grama contained 7 percent protein of which 69 percent was digested. In trial 9 the addition

Table 1.— Analyses of grasses and digestion trial data

Grass	Year	Location	Grass eaten per day	Crude protein	Crude fiber	Digestible protein	Total digestible nutrients
			Lb.	Pct.	Pct.	Pct.	Pct.
Blue grama (Near maturity)	1951	Cimarron	1.5	6.8* 46.6**	33.0* 55.2**	3.2	45.2
Blue grama (Near maturity)	1949	Lovington	2.0	5.2 47.3	31.3 52.4	2.4	43.3
Blue grama (Near maturity)	1950	Tucumcari	1.8	5.2 45.8	35.5 55.5	2.4	42.4
Blue grama (Fully mature)	1953	Las Vegas	1.5	7.3 52.2	31.3 51.3	3.8	40.3
Blue grama (Slightly weathered)	1949	Lovington	1.1	4.2 28.4	34.9 51.0	1.2	39.4
Blue grama (Severely weathered)	1952	Mescalero	0.8	2.4 0.0	38.1 50.2	0.0	35.8
Black grama (Severely weathered) (Plus 0.4 lb. C.S.M.)	1951	College Ranch	1.5	12.6 68.0	27.9 53.7	8.5	48.9
Black grama (Near maturity)	1952	College Ranch	1.8	7.1 68.9	30.1 55.7	4.9	46.9
Tobosa (Late flowering)	1952	College Ranch	2.3	8.9 75.3	30.7 62.2	6.7	52.7
Mesa dropseed (Late flowering)	1952	College Ranch	2.7	8.3 75.5	36.7 67.5	6.3	59.9

* First line of figures under crude protein and crude fiber are percent of composition.

** Second line of figures under crude protein and crude fiber are percent digested.

of 0.4 pound of cottonseed meal brought the total digestible nutrients above that of both the blue and black gramas.

Trials with tobosa and mesa dropseed are shown. These grasses were cut earlier, and were more immature than the other grasses, as is shown by the much higher protein. Note the high digestibility of the crude protein and also of the crude fiber. This tobosa and mesa dropseed as dried for feeding contained 66 and 76 percent as much total digestible nutrients as milo grain. This high feeding value is not surprising and is to be expected from the more immature grasses.

Total digestible nutrients in a grass depend upon the quality of that forage. Immature grass is high, mature grass is lower, and weathered grass is quite low in digestible nutrients.

A protein supplement when added to a weathered grass increased the calorie content, caused the animals to consume nearly twice as much grass, and raised the total digestible nutrients of the mixture up to that expected of a good quality grass.

WILL RANGE FORAGE CAROTENE MEET THE CAROTENE AND VITAMIN A REQUIREMENTS OF RANGE COWS?

Ward W. Repp

Vitamin A is a nutrient obtained by animals from their feed or manufactured by them from carotene which they obtain from their feed. The greener the forage, ordinarily the higher it is in carotene. Vitamin A is an important nutrient since it is required to maintain in a healthy condition the membranes lining the body cavities. With deficient levels of vitamin A the linings of the reproductive tract of cows, for example, are more susceptible to infections which cause increased numbers of dead or weak calves. A desirable characteristic of vitamin A, however, is that a 2- to 5-months' supply can be stored in the liver of the animal.

Considerable work has been done here at the College Ranch in analyzing range forage for carotene and the blood plasma of range cows for carotene and vitamin A. It was felt that similar data should be collected from other ranching areas of the State since considerable difference in plant species, soil type, altitude, rainfall, and other climatic conditions exist throughout the State. Six cooperating ranches were chosen as indicated on the map. Blood samples from 12 range cows and representative grass samples were collected on each ranch monthly from November through May. The forage samples were analyzed for carotene and phosphorus and the blood plasma for carotene, vitamin A, and inorganic phosphorus.

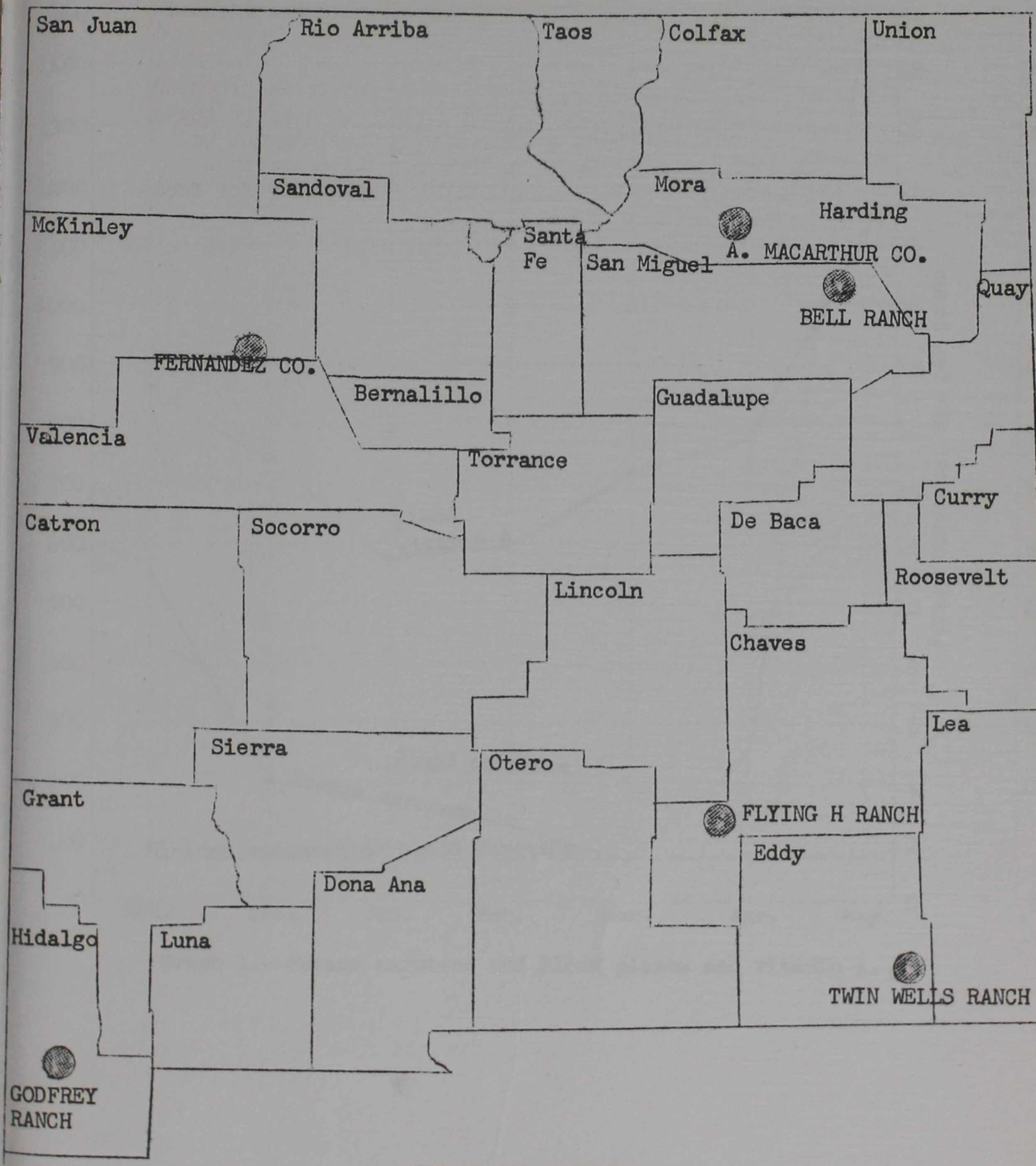
Graph 1 illustrates the average blood carotene and vitamin A and forage carotene for the six ranches during the 7-month period of collection. It will be noted that the shapes of the three curves are very similar, all showing a downward trend of values through the winter and early spring months and a very decided upward trend starting in April. The relationship of forage carotene to blood carotene and vitamin A was very close, with correlation coefficients for both of these relationships exceeding 0.90.

Various workers have reported blood levels of carotene necessary to maintain normal reproduction, and the lower limit as reported appears to be about 80 micrograms per 100 milliliters for mature cows and 100 micrograms for heifers. However, some recent work at the Oklahoma Agricultural Experiment Station indicates that the blood carotene level may drop considerably below these levels for periods of a month or more without adversely affecting the calf crop.

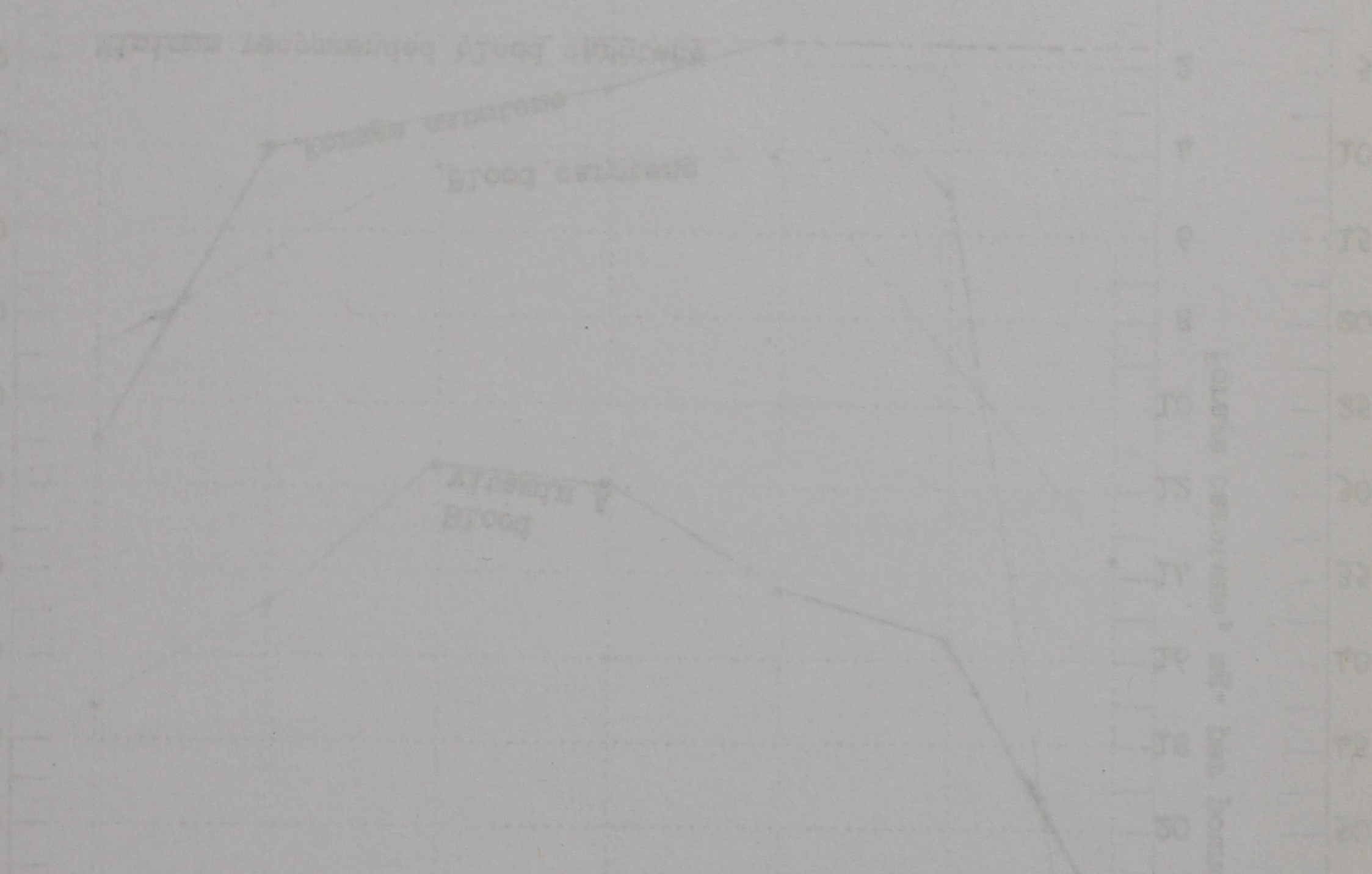
In this study the average carotene values for every ranch for every month were equal to or above the recommended levels for normal reproduction. On the three ranches in northern New Mexico, however, blood plasma levels on some individual cows fell below the recommended levels during the months of February and March. The experimental results obtained on the three ranches in southern New Mexico agreed well with previous results obtained here at the College Ranch. Blood plasma carotene and vitamin A from cows on these southern ranches remained well above minimum levels throughout the winter and early spring months.

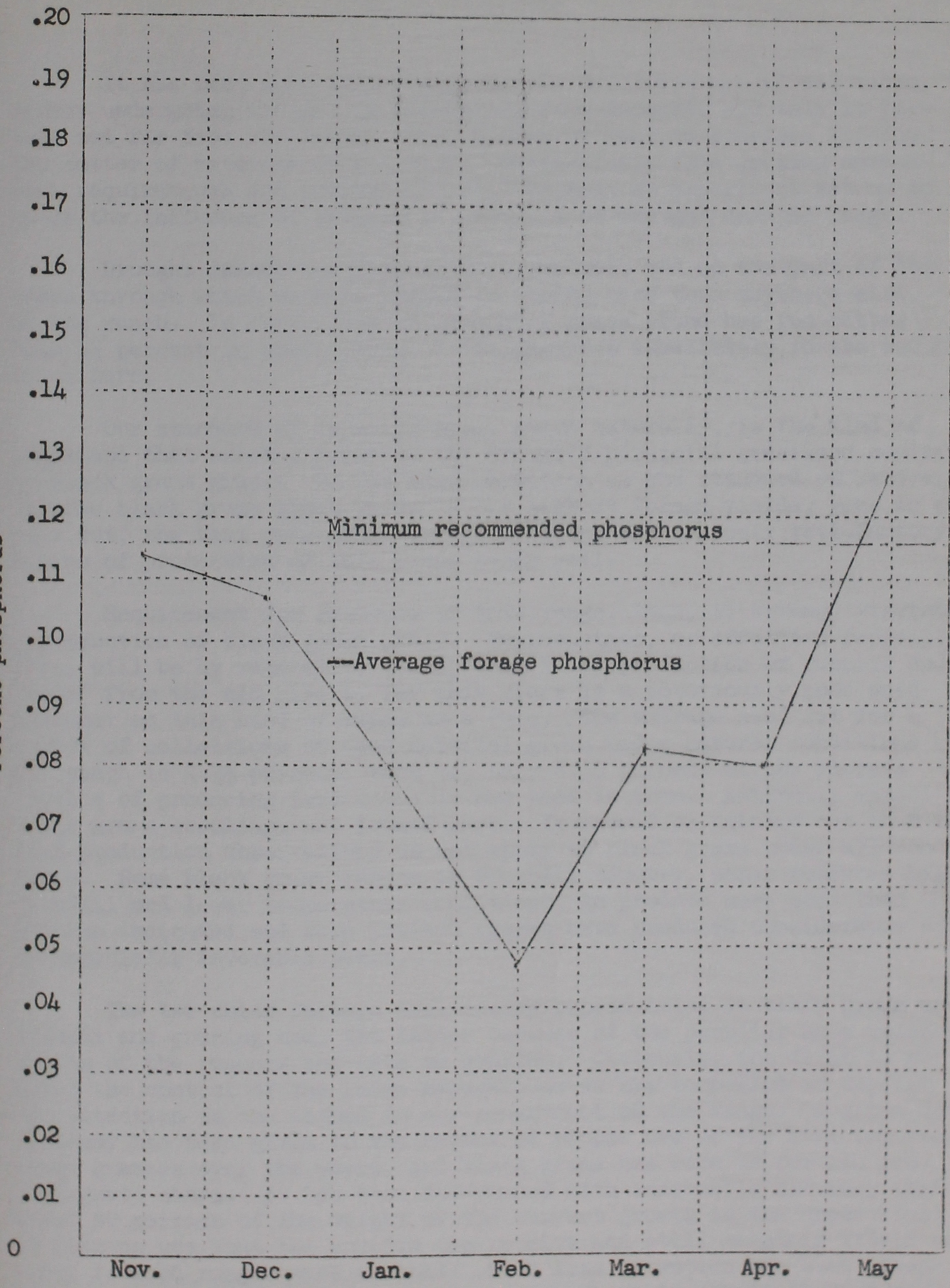
Data gathered on the phosphorus content of range forage is summarized in graph 2. For every month except May the average percentage of phosphorus for the six ranches was below the minimum recommended requirement.

On the basis of the first year's results (and it is proposed that this study continue for at least 2 more years) it appears that vitamin A supplementation for range cows in New Mexico may not be required. The forage phosphorus data confirm extensive previous work at this station and serve to reemphasize the necessity for feeding supplementary phosphorus in New Mexico.

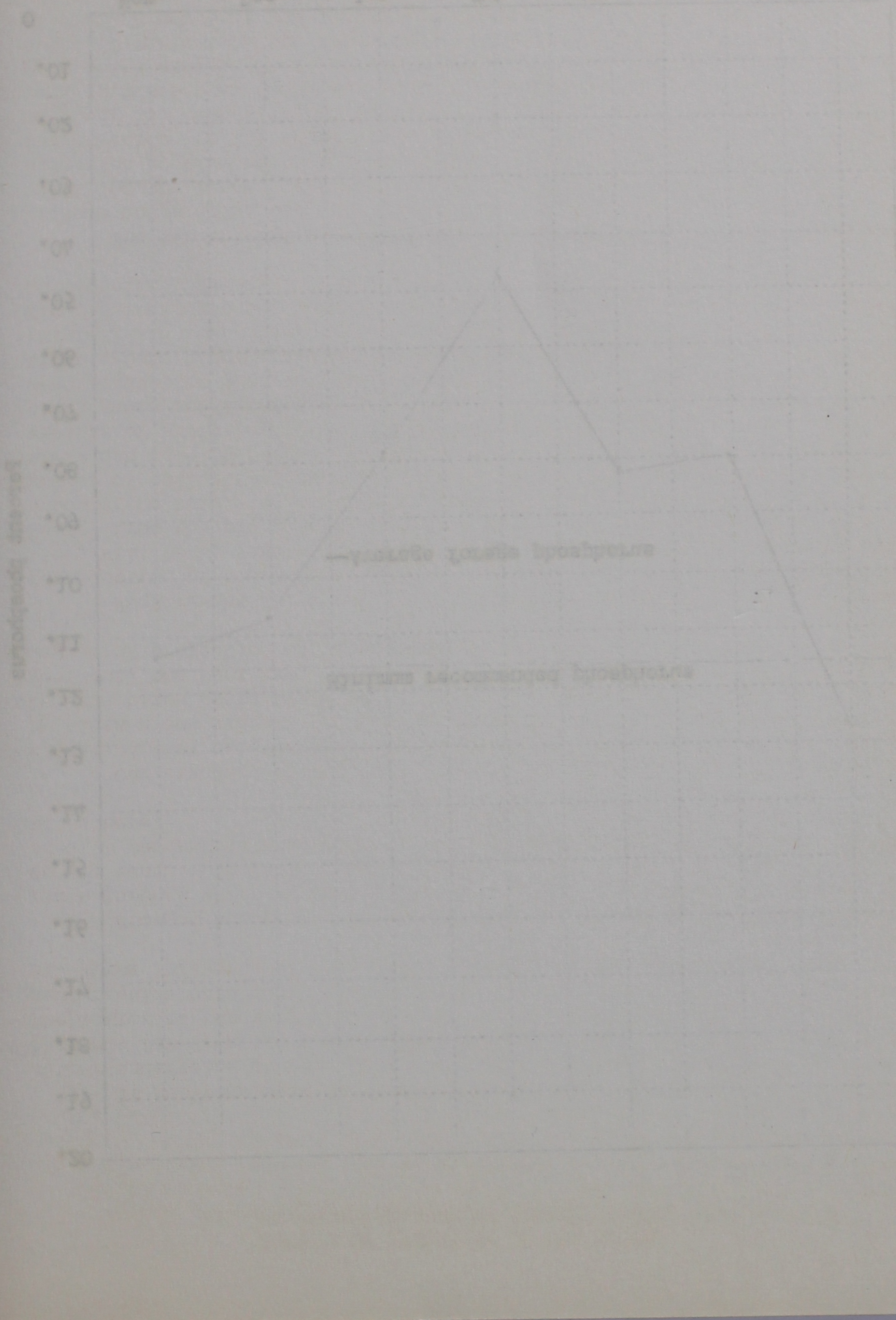


MAP OF NEW MEXICO


Graph I.—Graphic representation of blood urea and creatin.
Urea
Creatin
Blood urea
Blood creatin
Days
Mg. per 100 c.c. blood



Graph 2.--Forage phosphorus



EFFECT OF INTENSITY OF USE ON THE RECOVERY OF DROUGHT DAMAGED RANGE

K. A. Valentine

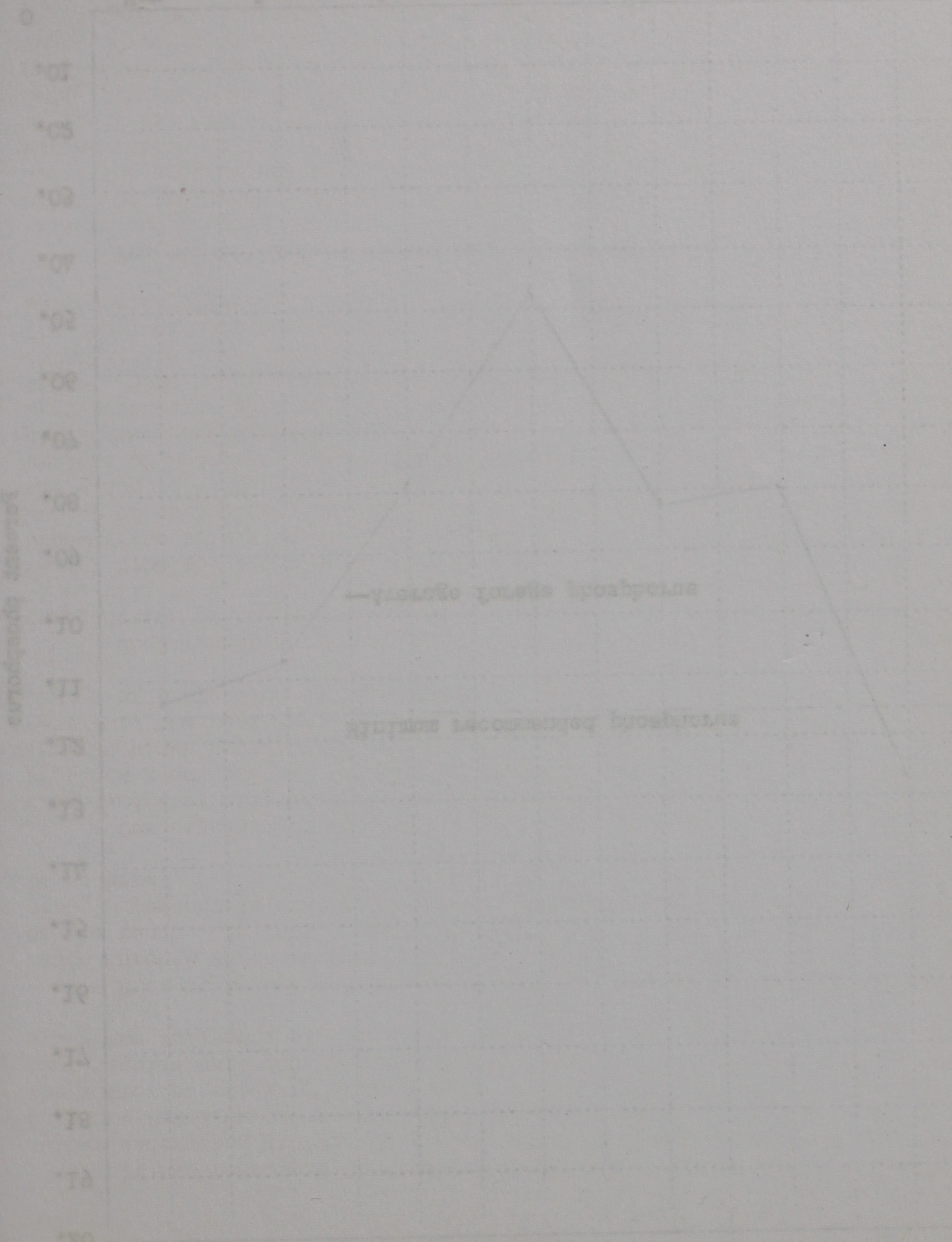
It has been said that ranges in the Southwest are at all times either undergoing drought or recovering from drought, and this is perhaps not far from the truth. Here today, we want to consider briefly the matter of recovery from drought, particularly some grazing management requirements and preliminary results from an experiment set up to study the influence of grazing on recovery of drought-damaged range.

Drought damage has been more severe here and on the part of the ranch through which we have passed in coming here than anywhere else on the ranch. In fact, loss of perennial grass stand has run better than 95 percent in some places in the pastures immediately to the south of us here.

Our standard of recovery here, quite naturally, is the kind of rangeland that existed prior to the drought--perennial grassland dominated by black grama grass. We set this condition as the standard of recovery because black grama grass gives us our highest forage yields, year in and year out, the best year-round forage quality, and the only satisfactory degree of protection of this loose sandy soil.

Requirement for recovery of this range, then, is strong, vigorous reproduction of black grama grass. Reproduction, or effective reproduction, will be by vegetative means, that is by production of runners and "sets" from the old plants, for this grass is a notoriously poor seed producer on this kind of range as a rule. The average seed set for a number of collections of seed material grown under natural conditions on the ranch is 4.35 percent; that is, only 4.35 percent of the florets capable of producing seed actually had seed in them. Naturally established black grama seedlings are indeed rare. It should be pointed out that these seed production observations do not apply to black grama under all conditions. Some black grama ranges in foothill country, under somewhat higher rainfall and lower temperature conditions, do produce more seed than the figures indicated and some lowland ranges have produced considerable seed in especially favorable years.

The two chief factors influencing reproduction in black grama are climate and grazing use, the latter because of the peculiar easy vulnerability of the runners and sets to grazing. Obviously, the first is not under the control of the range manager, so we are compelled to confine our attention to the second in our management of the range. A great deal of study has been given to the matter of proper use of the more important range grasses over the years, and black grama has come in for its proportionate share. It has been determined with reasonable accuracy that about 50 percent of the weight of the current growth is the upper limit of grazing use that the species can receive and still maintain itself on sandy lowland ranges such as this. Much less attention has been given to the matter of degree of grazing use necessary to permit or foster recovery from a drought-damaged condition. Mere maintenance is not enough; there must be a manyfold increase in reproduction over maintenance requirements if drought damage is to be repaired before the onset of another drought.



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Drought damage has been more severe here and on the part of the ranch through which we have passed in coming here than anywhere else on the ranch. In fact, loss of perennial grass stand has run better than 95 percent in some places in the pastures immediately to the south of us here.

Our standard of recovery here, quite naturally, is the kind of rangeland that existed prior to the drought--perennial grassland dominated by black grama grass. We set this condition as the standard of recovery because black grama grass gives us our highest forage yields, year in and year out, the best year-round forage quality, and the only satisfactory degree of protection of this loose sandy soil.

Requirement for recovery of this range, then, is strong, vigorous reproduction of black grama grass. Reproduction, or effective reproduction, will be by vegetative means, that is by production of runners and "sets" from the old plants, for this grass is a notoriously poor seed producer on this kind of range as a rule. The average seed set for a number of collections of seed material grown under natural conditions on the ranch is 4.35 percent; that is, only 4.35 percent of the florets capable of producing seed actually had seed in them. Naturally established black grama seedlings are indeed rare. It should be pointed out that these seed production observations do not apply to black grama under all conditions. Some black grama ranges in foothill country, under somewhat higher rainfall and lower temperature conditions, do produce more seed than the figures indicated and some lowland ranges have produced considerable seed in especially favorable years.

The two chief factors influencing reproduction in black grama are climate and grazing use, the latter because of the peculiar easy vulnerability of the runners and sets to grazing. Obviously, the first is not under the control of the range manager, so we are compelled to confine our attention to the second in our management of the range. A great deal of study has been given to the matter of proper use of the more important range grasses over the years, and black grama has come in for its proportionate share. It has been determined with reasonable accuracy that about 50 percent of the weight of the current growth is the upper limit of grazing use that the species can receive and still maintain itself on sandy lowland ranges such as this. Much less attention has been given to the matter of degree of grazing use necessary to permit or foster recovery from a drought-damaged condition. Mere maintenance is not enough; there must be a manyfold increase in reproduction over maintenance requirements if drought damage is to be repaired before the onset of another drought.

Here at this site we have established an experimental setup which, together with two other similar installations elsewhere on the ranch, is designed to give us the answer to the question raised. There are four plots in the enclosure here which have received and will continue to receive four different degrees of grazing use: light, moderate, full proper, and heavy. Since the plots were just established last year and have received only one season's grazing use, no easily observable differences between them exist at this time. This is as might be expected, since the effects of grazing use both harmful and nonharmful are commonly slow to develop, but become obvious only after a period of grazing treatment. Certain outward effects of the treatments are discernible, however, upon close examination. These effects are on the runner and set formation and are shown in the table below which is a summarization covering all plots in the study.

Table 1. Effect of degree of grazing use on formation of runners and sets by black grama grass

Degree of use	Average number of runners per plant	Average length of runners	Average number rooted sets per plant
		Inches	
Light (31.27 percent)	9.3	6.0	0.63
Moderate (39.50 percent)	9.7	5.2	.77
Full proper (60.53 percent)	7.6	4.2	.47
Heavy (60.55 percent)	5.7	4.7	.27

Now the differences brought out by these figures are certainly not striking, but they do show that the plots receiving the lighter degrees of use are exhibiting an early if but small advantage in recovery. There are a few more runners per plant, they average a bit longer, and they have established more new plants. We have not measured forage production on the plots yet this year, but it is very doubtful that the slight differences in reproduction will be measurable in terms of forage yield. This will come only after the more numerous small plants in the lighter use plots develop to forage-yielding size and more particularly as differences in reproduction are compounded with time. When these developments occur, we will return to this or one of the other installations on the ranch on future Ranch Days to observe and discuss these results.

There are two further points that might well be mentioned here in connection with the lighter degrees of use, which seem at this time to be necessary to stimulate recovery at the faster rates. First, black grama is not the only grass that yields forage on the area. Certain dropseeds, or sandgrasses, now coming in may be expected to yield a good share of forage and probably even outyield black grama in the earlier stages of recovery. If these grasses are used when most palatable and sought after, at the height of the growing season and particularly in early spring before the black grama greens up, use on the black grama should be minimized. Next, as you know, the lower portions of the stems in black grama remain live, green, and nutritious beyond the first year, so that grazing can be deferred until runners are produced and sets established, and much of the forage value of the grass can still be recovered.

THE EFFECT OF CONDITION ON EVALUATING TYPE IN RANGE CATTLE

R. L. Blackwell

Frequently stockmen have discussed the plan of breeding big cows to typey, high-grade bulls in order to reap the assumed advantage of the more productive females and better grading calves as the result of using the smaller but higher grading bulls. Another plan would be to mate smaller females to large bulls to produce growthy calves without the expense of maintaining unusually large cows. Both plans undoubtedly have advantages as well as disadvantages.

The mating of unlike individuals on the basis of their phenotypes generally results in offspring that are intermediate between the parental types. In most traits of domestic animals such a mating system is expected to produce a fairly uniform group. If intermediates are desired as compared to either one of the two extremes, this mating system obviously has some merit. It is of interest to find out more about the assumptions as regards the outcome of such matings as those indicated above.

Matings have been made to study this problem and data have been collected on weight, grade, and condition of the calves at weaning time. The years involved were 1953 and 1954. The weaning weights obtained during these years reflect the dry range conditions prevailing at that time. However, the differences between the mating types are of more interest than the actual level of production.

Two groups of range cows designated at "Big" and "Compact" were each divided and breeding groups were made up as follows:

compact cows x big bulls
compact cows x compact bulls
big cows x big bulls
big cows x compact bulls

The data have been summarized in table 1.

Table 1.-- Weaning weight, grade, and condition scores of calves from the various matings

	Type of cows	Type of bulls		Average
		Big	Compact	
Weaning weight, lbs.	Big	317.2	323.9	320.6
	Compact	273.1	281.8	277.4
	Average	295.2	302.8	299.0
Grade, score	Big	6.43	7.02	6.72
	Compact	6.43	6.75	6.59
	Average	6.43	6.88	6.65
Condition, score	Big	5.42	6.36	5.89
	Compact	5.14	5.50	5.32
	Average	5.28	5.93	5.60

Some points stand out clearly. The type of bulls has little effect on the weaning weight of calves. In these data the difference was slightly in favor of the compact bulls, but the difference is so small that little importance can be attached to it. The striking effect of type of cow on weaning weight of calves that has been found throughout the type studies is clearly in evidence here. The big cows produce the heaviest calves.

Referring next to the data on grade, the picture is not so clear. The calves from the compact cows graded lower than those from the big cows, while calves from the compact bulls graded higher than calves from the big bulls.

Condition is an important factor in calf production and it is undoubtedly important in the composite of things called grade. There is a positive correlation in these data between these two measures of merit. The data on condition score strongly indicate that big cows wean fatter calves than compact cows, and are thought to be chiefly a reflection of milk production of the cow. There appears to be some contradiction to this statement when we look at the averages of condition score for the two types of bulls. Calves from compact bulls were fatter than calves from big bulls.

A closer inspection of the portion of the table referring to individual mating groups indicates that the big cows produce fatter calves when they are bred to compact bulls than when the calves are sired by big bulls. The same relation appears to be true for the compact cows but to a lesser degree. The big cows produce a relatively greater milk supply for calves that are inherently smaller (sired by compact bulls) than for the calves sired by the big bulls. This relatively greater milk supply could obscure the effect of size of bull on weaning weight and accentuate the effect of type of cow. The somewhat confusing results on grade score may also be tied up with the condition of the calf. The poorer condition of the calves out of compact cows and big bulls tended to equalize the expected difference in grade between them and the calves out of big cows and big bulls. Similar reasoning appears to account for the slightly higher grade of the calves from big cows and compact bulls as compared to the calves out of compact bulls and compact cows.

These tentative explanations for the differences observed from these matings seem to be justified. Additional data should substantiate them if they are true. It would appear that big cows x compact bulls are a better combination than compact cows x big bulls when the evaluation is based only on weights, grade, and condition score of calves produced at weaning. Other considerations such as calving percentage, longevity, and lifetime production are needed to evaluate the mating plan more completely.

SELECTING COWS BY THE WEIGHT OF THEIR CALVES

J. H. Knox

Attempts at this station to classify mature cows on their appearance have not been successful. Cows selected as top producers raised little if any better calves than those which had been rated as poor producers. It may seem strange that we are able to select heifers fairly well and have so little success with cows. A big, thick, smooth heifer which has been raised on the range has what we are looking for, including good rustling ability. When we see these characteristics in a mature cow it is hard to tell whether she has them because she is the kind of cow we want or because she is a poor producer. The fattest cows in a herd are usually the dry cows, followed pretty closely by those that were dry last year and the poor milkers. It is not safe to pick the thin cows either. Sometimes they have raised good calves but just as frequently they are the weak ones, which is the last thing we want.

The failure of this plan caused us to look to the calves as a means of picking good cows. A study of our records showed that the weight of a calf is a good indicator of the weight of later calves produced by the same cow; much better than the grade of the calf is of the quality of future calves. This repeatability is the most important measure of a trait as a basis for selection. Some others are: its economic importance, the ease with which it can be measured, and the variation which is found in its expression. There can be no question of the importance of calf weight. Differences can be measured easily by scales or even by judgment, especially when variations are as great as those shown in the following table which gives the weight of calves produced on the college ranch over an 18-year period.

Year	Average weight	Top weight	Low weight	Range
1936	398	520	278	242
1937	461	604	305	299
1938	421	523	305	218
1939	443	563	325	238
1940	434	612	330	282
1941	426	626	281	345
1942	456	573	348	225
1943	348	447	248	199
1944	406	522	277	245
1945	403	516	268	248
1946	423	547	316	231
1947	433	562	325	237
1948	379	496	262	234
1949	444	560	306	254
1950	379	499	270	229
1951	334	446	216	230
1952	387	508	280	228
1953	321	440	238	202
Average	405	531	287	244

This table shows a range of 240 pounds in the weights of calves raised the same year and a difference of 120 pounds in the average weights of calves raised in different years. This not only provides a wide field for selection but illustrates that selection should be based on comparisons of calves raised in the same year instead of by a fixed standard to apply to all years. In this case the best plan is the simplest one. This is true especially when the work must be done without scales. It is easier to decide which are the largest calves in a crop than to estimate their actual weights. So we find that calf weight measures up well on all points. It is important. We have a wide variation to select from. Differences are easily measured, and it is fairly repeatable from year to year.

You may wonder why we did not select cows on the quality of their calves or by a combination of weight and quality. Either of these plans could be used. In fact, quality will usually be considered. This may be done by passing on each calf as it is weighed or by making the weight selection first and then discarding those which are unacceptable in type. We have two reasons for choosing weight at this time. As was stated previously, weight is a more reliable indicator of future production than grade. In addition, as is explained in another report, the cow has a much greater influence on weaning weight than the sire. In the case of grade, the influence of sire and dam is more nearly equal. We will try to demonstrate the effectiveness of this method with two groups of cows and calves. One group will be cows that weaned the heaviest calves last year and the other will contain those which raised the lightest calves in 1954.

Document Break

This is the end of the work.